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METHOD FOR PREVENTING REFLECTION OF EXTERNAL LIGHT OF PLANE
[Heimen disupurei no gaikohanshaboshi hoho]

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[Claim(s)]

[Claim 1] Method for preventing reflection of external light of plane, comprising a step of preparing a filter by forming a hardened film at least on the upper surface of a transparent plastic film or sheet and laminating an antireflection layer on the hardened film and a step of adhering the surface of filter not laminated with the antireflection layer over the display surface of a flat display.

[Claim 2] Method for preventing reflection of external light of plane according to Claim 1, wherein the transparent plastic film or sheet is an acrylic resin film or sheet.

[Detailed Explanation of this Invention]

[0001] [Industrial Application]

This invention relates to an external light reflection prevention method for a flat screen display such as liquid crystal display, plasma display, and EL display.

[0002] [Description of the Prior Art]

A flat-screen display, such as liquid crystal display, plasma display, and EL display, is widely utilized for television, word processor, personal computer, etc. However, due to external lights reflecting the display surface, the display screens of these flat-screen displays are hard to see. To prevent the reflection of external light of this type of flat-screen display, conventionally, various filters (e.g., transparent sheet having fine surface irregularity, reflection prevention filter using a color plate,

circularly polarized light filter, etc.) are used to cover the screen, or the display surface is treated to have fine roughness, and so on.

[0003] However, the method of using a transparent sheet having fine roughness on the surface, or forming fine roughness to the display screen requires significantly rough surface roughness is needed for preventing the external light reflection. Therefore, the displayed image becomes blurring. When a reflection prevention filter using a colored plate is applied, the screen becomes darker, and the antireflection effect is insufficient. The circularly polarized light filter makes the screen darker. Thus, every method cannot provide satisfactory result.

[0004] Based on this background, the developers of this invention thoroughly investigated the external light reflection prevention method for flat-screen display and found that, by forming a hardening film at least on the top face of a transparent plastic film or sheet and laminating an antireflection layer on the hardened film and adhering the surface of filter not laminated with the antireflection layer over the display surface of a flat display, the conventional problems can be eliminated, and the external light reflection can be efficiently prevented while maintaining the screen brightness. Hence, the present invention was completed.

[0005] [Means for Solving the Problem]

That is, this invention provides a method for preventing reflection of external light of plane, comprising a step of preparing a filter by forming a hardened film at least on the upper face of a transparent plastic film or sheet and laminating an antireflection layer on the hardened film and a step of adhering the surface of filter not laminated with the antireflection layer over the display surface of a flat display. Hereafter, this invention is explained in detail.

[0006] The filter used in this invention is prepared by forming a hardened film at least on the upper face of a transparent plastic film or sheet and laminating an antireflection layer on the hardened film. The transparent film or sheet can be prepared from a cellulose type resin, such as acrylic resin, polycarbonate type resin, polyester, triacetyl cellulose, and diacetyl cellulose, etc., polypropylene resin, glutar imide type resin, etc. Among those materials, an acrylic resin film or sheet is preferable considering the weatherability, where an acrylic resin film or sheet having impact resistance, such as acrylic resin prepared by dispersing acryl rubber in an acrylic resin, is particularly preferred. Considering the handling easiness and effectiveness when the film or sheet is adhered to a flat-screen display, the thickness of the transparent plastic film or sheet is normally 0.01 - 1.5 mm, where the thickness

of 0.1 - 1.5 mm is preferably used as such thickness allows the film to function as a protection film for the display screen.

[0007] An example of the hardened film formed at least on the top surface of a transparent plastic film or hardened film is a hardened film prepared by polymerizing and hardening a polyfunctional monomer. Practical examples are materials prepared by crosslinking and hardening a crosslinking resin marterial containing at least two acryloyl groups or methacryloyl groups urethane (metha) acrylate, polyester (metha) acrylate, polyether (metha) acrylate, etc. using an active energy ray, such as ultraviolet ray, electron ray, etc.; materials prepared by thermally crosslinking and hardening a silicone type, melamine type, or epoxy type crosslinking and hardening raw material; etc. Among those materials, considering the durability and adhesive characteristic at the time of laminating, by hardening an urethane acrylate type resin raw material, polyester acrylate type resin raw material, etc. using an ultraviolet ray or electron ray or by thermally hardening a silicone type resin raw material, an excellent film can be produced. The hardened film needs to be formed at least over the upper surface (the side where an antireflection layer is laminated). However, a hardened film may be provided to the other side (the surface adhered to the flat-screen display) of the surface laminated with an antireflection layer in order to improve the durability.

[0008] As an antireflection layer, at least one inorganic compound thin film needs to be deposited over the upper surface of hardened transparent plastic film or sheet using a vacuum deposition method, painting, etc. The inorganic compound may be yttrium oxide, calcium fluoride, sodium fluoride, cryolite, lithium fluoride, magnesium fluoride, silicone dioxide, lanthanum fluoride, neodium fluoride, aluminum oxide, cerium fluoride, lead fluoride, magnesium monoxide, thorium oxide, tin oxide, lanthanum trioxide, silicone monoxide, indium oxide, neodium oxide, antimony oxide, zirconium dioxide, cerium oxide, titanium oxide, zinc sulfide, bismuth oxide, zinc selenide, cadmium sulfide, antimony trisulfide, cadmium telluride, silicon, germanium, tellurium, lead telluride, etc. When two or more layers of these materials are laminated, each layer may consist of a different material.

[0009] By adhering the non-laminated side of the filter prepared as described above to the display surface of a display device (e.g., liquid crystal display, plasma display, EL display, etc.), the reflection of external lights on the display screen can be prevented. For adhering the filter to the display screen, an adhesive agent, binder agent, etc. is used. In order to prevent the air from coming in between the display surface and filter, the filter is preferably press-adhered for obtaining effective prevention of external light reflection.

[0010] When applying this invention to a liquid crystal display, the filter may be adhered to the polarizing plate used to the display side of a liquid crystal display beforehand so as to prepare a polarized plate having a filter. Then, the non-filtered side of plate may be adhered to the display screen so that the filter can be exposed. In this case, when adhering the polarized plate to the liquid crystal cells, the filter can be simultaneously provided. Thereby, the liquid crystal display having an external light reflection prevention function can be efficiently prepared.

[0011] [Effect of the Invention]

According to the method based on this invention, the external light reflection on the surface of flat-screen display can be prevented efficiently while keeping the bright screen.

[0012] [Operational Examples]

Hereafter, this invention is further explained in detail by referring to the operational examples. Note that this invention is not limited to an example.

Operational example 1:

An urethane acrylate type hard-coating agent (Dainippon Ink, trade name: "Unidick 17-806") was coated over both sides of 1200 mm x 300 mm x 0.25 mm impact-proof acrylic sheet (Sumitomo Chemical, trade name: "Technoroy") and hardened, thereby providing an average 4 μm thick hardened film to both sides. Then, yttrium oxide, titanium oxide, and the silicone oxide thin films were sequentially laminated

in this order on one side of the hardened film sheet, providing an antireflection layer consisting of three layers to form a one-sided reflection prevention filter. The obtained filter is adhered to the liquid crystal television screen using an acrylic type binding agent. Then, the external light reflection and brightness of television screen were examined. The results are shown in Table 1.

[0013] Comparison example 1:

A one-sided antireflection filter obtained in the same manner as described in the operational example 1 was placed in front of a liquid crystal television. Then, the external light reflection of the television screen and brightness of the television screen were examined. The result is shown in Table 1.

[0014] Comparison examples 2 - 3:

A circularly polarizing light filter was created by adhering a circularly polarizing light film to the non-laminated side (not laminated with the antireflection layer) of one-sided antireflection filter obtained according to the method described in the operational example 1. Then, the filter was adhered to a liquid crystal television screen using the same method as described in the operational example 1 or comparison example 1, or placed in front of the liquid crystal screen. Then, the condition of external light reflection and brightness of the television screen were examined. The results are shown in Table 1.

[0015] Comparison examples 4 - 5:

After a 1 mm thick hardened film was formed on both sides of colored acryl sheet (total ray permeation ratio = 60%), an antireflection layer identical to the layer prepared in the operational example 1 was formed on both sides of this hardened film sheet. Hence, a both-sided colored antireflection filter can be provided. Then, this filter was adhered to the liquid crystal television screen using the same method as described in the Operational example 1 or Comparison example 1, or placed in front of the liquid crystal television screen. Then, the condition of external light reflection and brightness of the television screen were examined. The results are shown in Table 1.

Comparison examples 6 - 7:

An antireflection layer identical to the one prepared in the operational example 1 was formed on both sides of hardened film forming sheet prepared as described in the operational example 1 so as to create a both-sided antireflection filter. Next, the filter was adhered to a liquid crystal television screen using the same method as described in the operational example 1 or comparison example 1, or placed in front of the liquid crystal screen. Then, the condition of external light reflection and brightness of the television screen were examined. The results are shown in Table 1.

[0017] Operational example 2:

The one-sided antireflection filter obtained in the same manner as described in the operational example 1 was adhered to the EL display screen using an acrylic type binder agent. Then, the condition of external light reflection and brightness of the television screen were examined. The results are shown in Table 1. Note that the external light reflection and screen brightness were rated according to the following rating method:

External light reflection:

O: Almost no reflection; Δ: Medium level of reflection; X: Significantly reflected

Screen brightness:

O: Bright; X: Dark

[Table 1]

Experiment No.	Display kind	Filter kind	Filter setting method	External light reflection	Screen brightness
Operational example 1	Liquid crystal TV	One-sided anti reflection	A	O	O
Comparison example 1	"	"	B	X	O
Comparison example 2	"	Circular polarization	A	O	X
Comparison example 3	"	"	B	O	X
Comparison example 4	"	Colored both-sided	A	X	X
Comparison example 5	"	"	B	Δ	X
Comparison example 6	"	Both-sided antireflection	A	X	O
Comparison example 7	"	"	B	X	O
Operational example 2	EL display	One-sided antireflection	A	O	O

A: Adhered to the display screen
B: Placed in front of the display screen